

CLAIMS

WHAT IS CLAIMED IS:

1. A water softener comprising:
a cation exchange resin tank fluidly coupled for passing spent brine comprising monovalent and divalent ions; and
an ion-separation device fluidly coupled to the resin tank to receive the spent brine and separate the spent brine into first and second streams, the first of the streams substantially comprising monovalent ions and the second of the streams substantially comprising divalent ions.
2. The water softener of claim 1 wherein the ion-separation device comprises a nanofiltration membrane.
3. The water softener of claim 1 wherein the first of the streams comprises regenerated brine and is coupled to a brine storage tank for further reuse for cation exchange resin regeneration.
4. The water softener of claim 3 wherein the second of the streams comprises a dischargeable stream comprising hardness-causing ions.
5. The water softener of claim 1 wherein the monovalent ions are selected from the group consisting of sodium and chloride.
6. The water softener of claim 1 wherein the divalent ions are selected from the group consisting of calcium, magnesium and carbonates.

7. A water softener comprising:
 - a cation exchange resin tank fluidly coupled for passing spent brine comprising monovalent and divalent ions;
 - a fluid mixer valve coupled to the resin tank and to a water tank to dilute the spent brine to a desired concentration of a regenerant salt; and
 - an ion-separation device fluidly coupled to the fluid mixer valve to receive the diluted spent brine and separate the diluted spent brine into first and second streams, the first of the streams substantially comprising monovalent ions and the second of the streams substantially comprising divalent ions.
8. The water softener of claim 7 wherein the ion-separation device comprises a nanofiltration membrane.
9. The water softener of claim 7 wherein the first of the streams comprises a diluted stream of monovalent ions and is coupled to a filter device for providing a concentrated stream of monovalent ions and a stream of substantially demineralized water.
10. The water softener of claim 9 wherein the filter device for providing the concentrated stream of monovalent ions and the stream of demineralized water comprises a reverse osmosis filter.
11. The water softener of claim 9 wherein the second of the streams comprises a dischargeable stream comprising hardness-causing ions.
12. The water softener of claim 9 wherein said water tank is coupled to receive the demineralized water.
13. The water softener of claim 12 wherein said water tank is coupled to the fluid mixer valve to supply water for diluting the spent brine.

14. The water softener of claim 7 further comprises a pump device fluidly coupled to draw liquid through the fluid mixer valve from a spent brine holding tank and said water tank, said liquid to be delivered to the ion-separation device.

15. The water softener of claim 9 wherein said concentrated stream of monovalent ions comprises regenerated brine.

16. The water softener of claim 7 wherein said regenerant salt comprises sodium chloride.

17. A method for purifying and recycling spent brine in a water softener, the method comprising:

passing from a cation exchange resin tank spent brine comprising monovalent and divalent ions;

diluting the spent brine to a desired concentration of a regenerant salt; and

separating the diluted spent brine into first and second streams, the first of the streams substantially comprising monovalent ions and the second of the streams substantially comprising divalent ions.

18. The method of claim 17 wherein the first of the streams comprises a diluted stream of monovalent ions and said method further comprises filtering said first stream for providing a concentrated stream of monovalent ions and a stream of substantially demineralized water.

19. The method of claim 17 wherein the second of the streams comprises a dischargeable stream comprising hardness-causing ions and said method further comprises discharging said second stream to a sewer.

20. The method of claim 18 wherein said concentrated stream of monovalent ions comprises regenerated brine.

21. The water softener of claim 17 wherein said regenerant salt comprises sodium chloride.